A Medium Resolution Population Database for Africa

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Introduction

This document describes a medium resolution population database for the African continent. The paper presents the motivation for assembling the database, and discusses data issues and the conventions used for adding the population data to a digital data set of administrative unit boundaries. Furthermore, problems and limitations of working with these data are discussed and, finally, some possible improvements and extensions are suggested. The current data set is not seen as a final product but rather as a first step in an ongoing data collection effort. The dissemination of these data will hopefully lead to contributions of additional data, and may also generate interest in follow–up work to enhance and expand the database.

The database described in this paper builds on earlier work on the construction of a similar data set for the United Nations Environment Programme's *World Atlas of Desertification* (UNEP 1992). In order to link environmental degradation processes to the distribution of human population, a digital map of estimated population densities was constructed which was subsequently used in analysis (see Deichmann and Eklundh 1991). The current effort aims at augmenting and improving the data sets assembled during the desertification atlas project in order to provide a consistent coverage of population figures.

The term *medium resolution database* was used in the overview by Clarke and Rhind (1992), who recommended the construction of such databases for the whole globe. *Medium resolution* commonly means the first or second level administrative boundaries within each country, thus filling the gap between national level data, which is readily available from a multitude of sources, and data on a larger cartographic scale, i.e., census tracts and enumeration districts. While the latter data can be employed in project level, local studies, the data volume involved would be too large for many regional, continental or global studies. Areas of work in which a medium resolution population database could be useful are:

- as an input to global models of human–environment interaction and for the study of the human dimensions of global change (see Clarke and Rhind 1992),
- for investigating the patterns of global land–use changes (IIASA 1993),
- for large scale epidemiological studies (i.e., Cliff and Haggett 1991, Smallman–Raynor *et al* 1992),
- for global migration studies (Ogden 1984),
- for use in survey planning to guide sampling design, or
- as a spatial reference base for assembling additional demographic, agricultural or other socioeconomic data layers.

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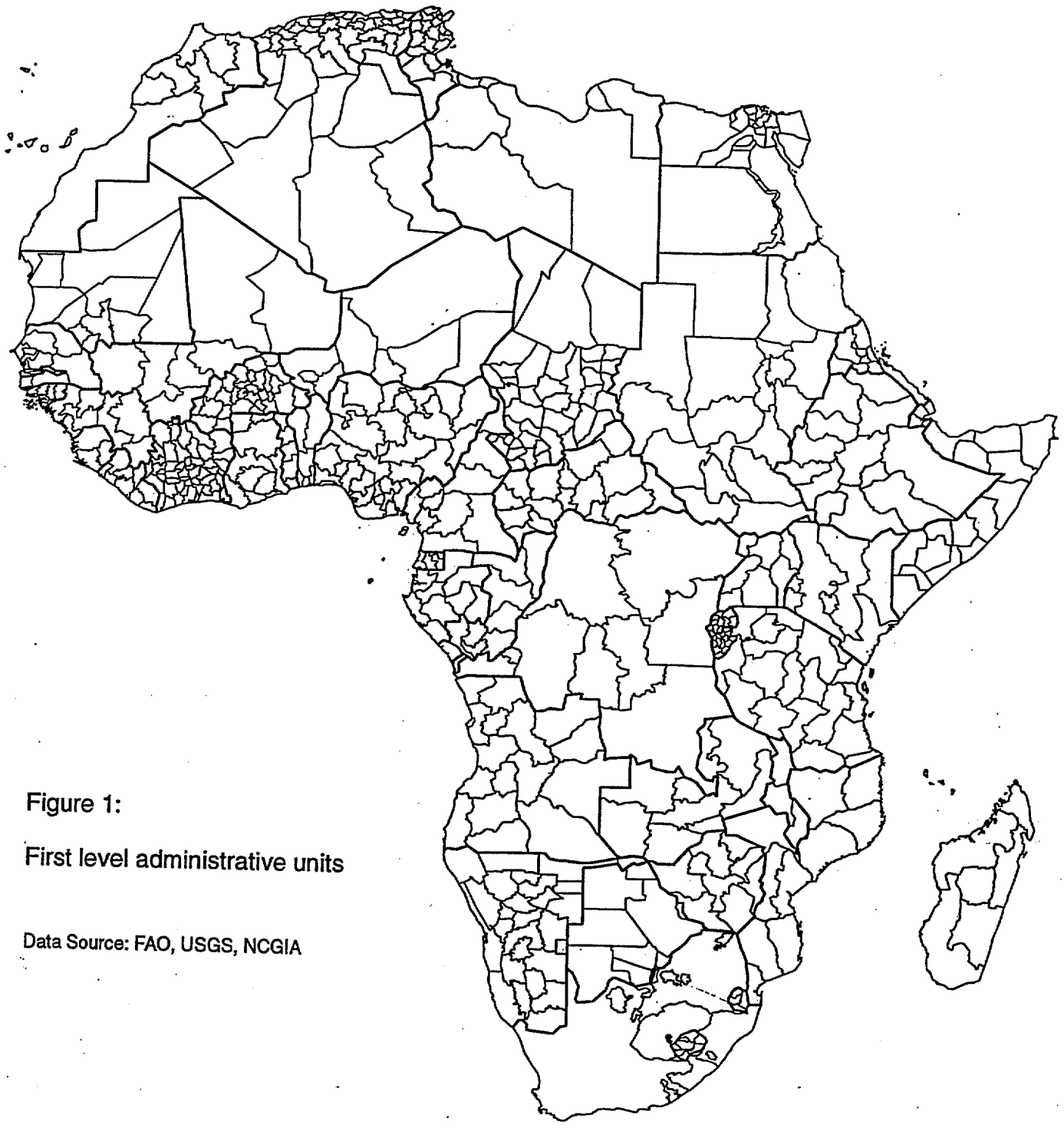

Figure 1:

First level administrative units

Data Source: FAO, USGS, NCGIA

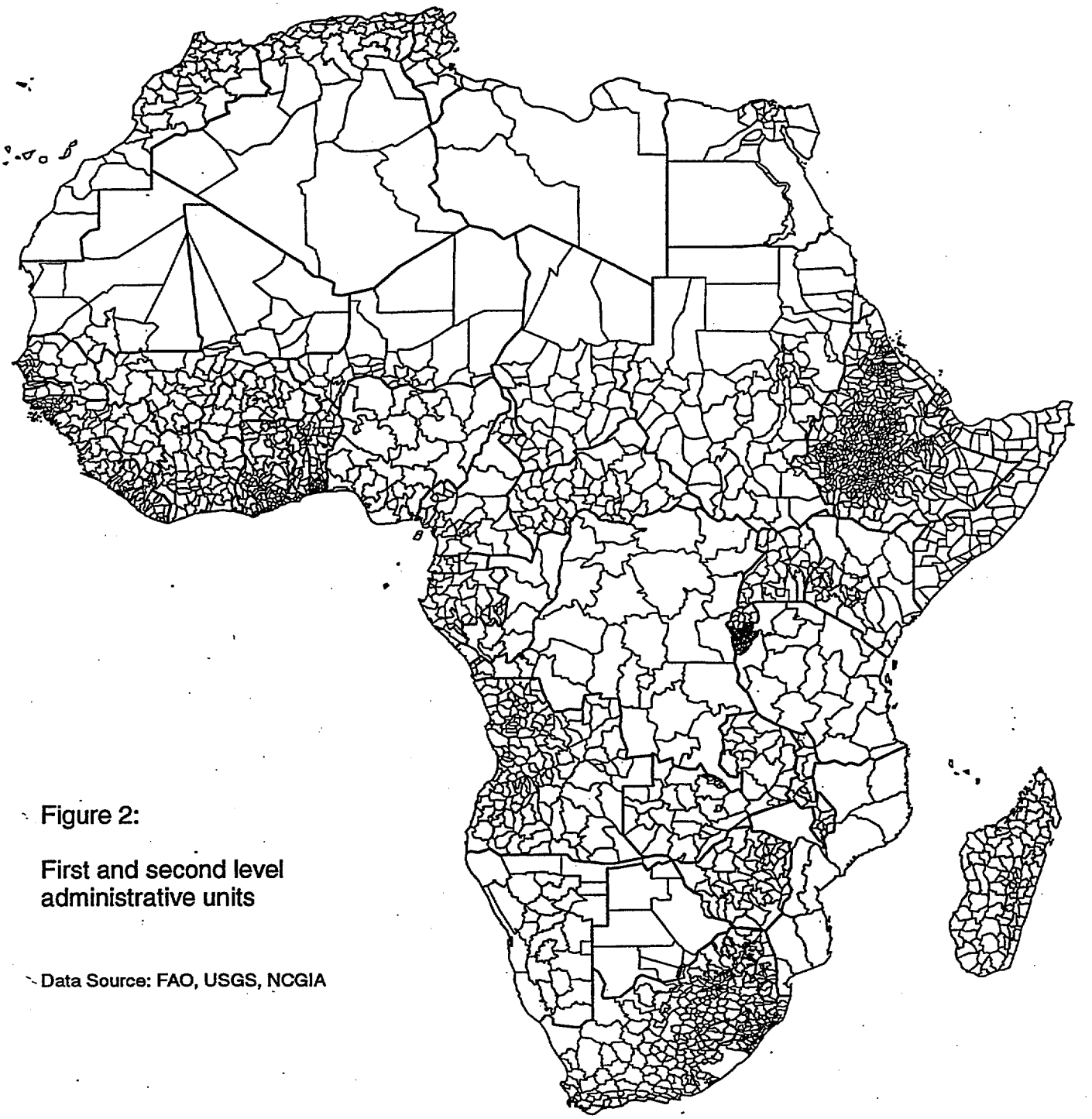

Figure 2:

First and second level administrative units

Data Source: FAO, USGS, NCGIA

Database Development

Population figures that were obtained from published sources were referenced to a geographical coverage of administrative area boundaries. The coverage used for this project has been produced by the United Nations Food and Agricultural Organisation (FAO) and contains first level administrative regions for all countries (Figure 1), and second level boundaries for about half of the countries in Africa (see Figure 2). The coverage documentation does not contain information about the source maps from which the boundaries were digitized. For several countries the boundaries were modified or replaced with information from various other sources (see notes in the appendix).

A variety of data sources have been utilized to add total population figures by administrative units to the attribute table of this coverage. The three principal types of sources that have been used are:

- **Published digital databases.** These consist of electronic databases such as the U.S. Bureau of the Census International Database and digital spatial databases, for example, UNEP/FAO's African Database.
- **Gazetteers and year books.** These regularly present detailed national and some regional level data for all countries of the world.
- **National census publications.** Where possible, information was taken from official census publications produced by the statistical offices in the individual countries.[2]

Appendix A provides a summary of the data by country. It indicates whether population figures were included for the first or second level, and whether the second level boundaries are available. For a few of the countries for which detailed spatial boundary data are available, no corresponding population figures could be identified so far. The data summary table also gives indicators of spatial detail of the administrative units by country. The first is the mean resolution in kilometers (*spatial resolution*) which is defined for each country as

$$\textit{mean resolution in km} = \sqrt{(\textit{area in km}^2) \ / \ (\textit{number of units})}$$

This resolution varies greatly by country. Even when comparing resolutions for the same level of administrative regions, large differences are found. Resolution, of course, depends to some extent on the size of the country and the average population density. For example, since census regions are usually designed to include an approximately equal number of people, the size of administrative units is generally larger in sparsely populated regions than in high density regions. A further useful indicator of detail is therefore the average number of people that a census region represents (*contextual resolution*). Again, large variations become apparent between Cape Verde and Burundi on the one hand, and Nigeria and Egypt on the other hand.

As indicated in the appendix and summarized in Figure 3, data were available from censuses in the mid to late eighties for most countries. Also included in the table is the year of the planned or completed census for the 1985–95 census round which was listed by Clarke and Rhind (1991). It indicates those countries for which improved figures might already have been published, or will be available soon. It should be noted, however, that the period between census completion and publication of the results is often very long.

The published census information did not always match the geographical base map perfectly. This is most likely due to reporting zone changes between the time of census publication and digiti-

2. The following library catalogues provided most of the references to the data sources: University of California libraries (telnet melvyl.ucsb.edu), Harvard University (hollis.harvard.edu), and the Library of Congress (locis.loc.gov).

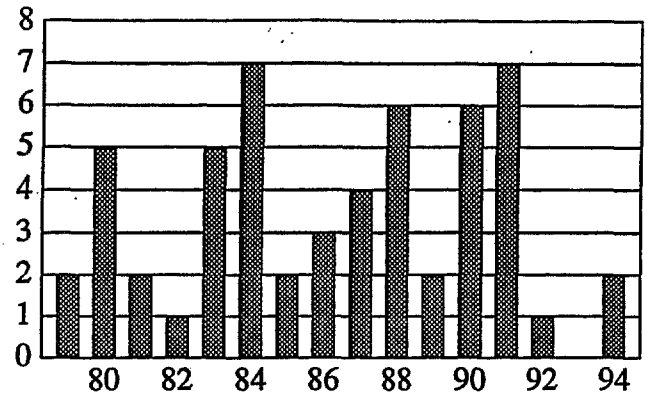

Figure 3: Frequency of Census Years

zation. For the countries where this is the case, the aggregation flag indicates whether there were more population data values available than there were regions digitized in the map. Commonly, for example, the national capital is treated as a separate reporting entity in a census publication, but was included in a neighboring region in the base map. For Zimbabwe, population figures were reported on the third level but not consistently for the second level. In these cases, the population figures were simply aggregated to match the regions in the coverage. Whenever possible, maps in the census publications or other cartographic sources were used to verify the GIS coverage, and in a small number of cases, inconsistencies in the source coverage were corrected.

A more complicated case is where there were more regions indicated on the coverage than there were population figures available on the same level. Most likely this occurs because the coverage already includes the more detailed newer boundaries while the population figures are for a previous, partly incompatible set of census regions. In these cases, the total population were distributed using a simple areal weighting scheme, although more complex estimation methods would be possible (see Goodchild *et al* 1993). It is likely that in these cases, more recent data or boundary files will be available soon which will not require disaggregation.

The table in the appendix also lists the total population for the reference year as indicated by the various sources. In order to facilitate cross–country comparisons, the coverage also contains a population estimate for 1994 for each census region. The predicted totals for each country are listed in the appendix together with the official UN estimate (United Nations 1993). The population projections were derived using a simple exponential growth model of the form

$$P_{ty} = P_{cy} \cdot exp\left(\sum_{i=cy}^{ty-1} r_i \,/\, 100\right)$$

(see Rogers 1985) where P_{ty} and P_{cy} are the regional populations in the target year (1994) and in the census year respectively, and r_i is the annual percentage growth rate in year i for the particular country. Average annual growth rates are published by the United Nations for five year intervals and have been linearly interpolated to produce rates for each year. The original rates are presented in the data summary table. Clearly, this approach naively assumes that population growth has been uniform in all regions, thus ignoring inter–regional disparities and migration. The census publication used for Zimbabwe, for example, includes regional growth rates for third level administrative units between the 1969 and 1982 censuses. These vary widely from average annual decreases of up to 4% to increases of more than 10%. The actual error introduced will vary depending on how current the reported population totals are. A better estimate can be derived once rural/urban shares by region

have been compiled. These could be used to project the two population components separately in each region using urban and rural growth rate estimates.

Data Quality Issues

The national totals predicted by the exponential model generally match the published UN estimates quite well. This is not surprising, given that they rely on the same growth rates. Major deviations occur for countries where the prediction interval is fairly long, or where other circumstances cause uncertainty. The most obvious example is Nigeria which recently had its first successful population count since independence. The results suggest a total population in 1991 of 88.5 million compared to the World Bank estimate of 99 million and the UN estimate of 112 million for the same year. A second example is Gabon for which the 1976 census total was approximately 1.2 million; a figure that was disputed by the United Nations and the World Bank (the official World Bank estimate for 1976, for instance, is 668,000). Although recent official estimates for Gabon are closer to the current UN estimates, there is still a considerable deviation which is reflected in the projections.

These examples should provide further encouragement to data users to interpret African demographic data within considerable confidence margins. Many developing countries lack the resources and infrastructure to provide timely and accurate information about their population in regular intervals. A number of countries have had their first successful census only in the last few years. In other cases, what is published as census data is more likely an estimate or an educated guess. In countries with significant nomadic or tribal cultures the undercount problem can significantly bias official census figures. Other factors increase the uncertainty about the actual current population of a region or country. After a recent turmoil in Burundi, for example, an estimated 10% of the population – approximately 500,000 people – are believed to have fled the country (BBC World Service news, Oct 26, 1993). The number of refugees fleeing war or food crises in many parts of Africa can often only be guessed. The journalist Robert Kaplan, for example, wrote in the *Atlantic Monthly* (February 1994) about the situation in West Africa:

> *"As a consequence, roughly 400,000 Sierra Leonians are internally displaced, 280,000 more have fled to neighboring Guinea, and another 100,000 have fled to Liberia, even as 400,000 Liberians have fled to Sierra Leone."*

Inconclusive evidence about prevailing demographic processes in developing countries add further uncertainty. For example, it is generally taken as given that cities have grown explosively in low–income developing countries as a result of migration from rural areas (i.e., Todaro 1985). Yet, Lipton and Lipton (1993) declare this *"a myth"*, and suggest that urban growth in low income developing countries is due to natural increase, expansion of official urban boundaries, or changes of urban/rural definitions. Furthermore, in–migration by young people is assumed to be partly compensated by out–migration by older people. For a discussion of this issue see Keyfitz (1980) or Rogers (1982).

There are also considerable obstacles to cross–national demographic analysis such as the inconsistencies of definitions between different countries. In studies of economic development or food security issues, major research questions relate to the increasing share of the urban population that is dependent on food production by a disadvantaged rural sector. For cross–national comparisons it would be useful to obtain reliable information about the shares of rural and urban population by subnational administrative regions. However, the definitions used in different countries vary widely. Haggblade *et al* (1989) provide a list of rural/urban definitions for a number of developing countries. In the countries reviewed, the definitions of rural settlements range from localities with

less than 1,000 inhabitants in Senegal to those with less than 10,000 in Mauritania and Togo. A comparison of this variable across countries is therefore very difficult.

This anecdotal evidence is a sample of the problems encountered when working with African demographic data (see Clarke and Rhind, 1992, for a more general discussion). They also serve to make the point that no absolute measures of data quality can be attached to this coverage. Usually, there is simply not enough information about data collection and processing that precedes the publication of census results. Instead, the approach taken here is to pass all available information regarding data sources, spatial and contextual resolution, and data currency to the user, who can then make his or her own decision about whether or not the data are appropriate for a given task.

Improvements and Extensions

As mentioned previously, rather than providing a static product, this GIS coverage presents a dynamic database which can be continuously improved and updated. Some straightforward improvements are possible by obtaining detailed data for those countries for which second level boundaries but not the corresponding population figures are available; and by including more recent census data for those countries that have had a recent population count but for which these data could not yet be obtained.

Next, it would be possible to add additional boundaries defining second level administrative units to the coverage for countries where the currently available detail is unsatisfactory. A related issue is the addition of very detailed spatial coverages for countries for which agencies or researchers have produced GIS databases for third level administrative units or for census divisions such as enumeration districts. Such efforts are planned, under way, or completed at several research institutions and agencies as well as at the United Nations Statistical Office. The framework provided by storing these data in a GIS makes it possible to ensure consistency among these data sets at different scales and resolution levels. These data do not have to be physically stored within the same database, but could instead form a distributed network of coverages for different spatial units. This requires coordination among data collecting agencies regarding reference boundaries (i.e. the Digital Chart of the World), data formats, and variable definitions. The result would be the "family of databases" that was envisioned by Clarke and Rhind (1992).

Additionally, also the scope of the database could be broadened. Demographic indicators such as sex–ratio, urban/rural population, or age distribution by region are available for many regions. It will be much more difficult to compile consistent regional economic or social indicators for all of Africa, although these are compiled in some countries. Finally, besides improving spatial and sectoral resolution, an important part of future work should be to improve the temporal resolution of the database. A dynamic demographic component could be included into the database by adding regional population figures from previous census rounds which would allow more accurate projections to common base years. There are clearly many ways in which this database could be improved, and hopefully, this documentation will turn out to be a small step towards such work.

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Appendix A: African Medium Resolution Population Database Data Summary Sheet (February 1994)

Num	Abb	UN Code	Country	Level used	2nd level avail?	Num of units	Ref year	Sched. census 85-95	Source	Agg flag	Country population (in 000) In ref yr (source)	In 1994 (projected)	In 1994 (UN est)	Abs. % error	Annual rates of change 80-85	85-90	90-95	Mean resolution in km	Mean pop per unit (in 000)
1	AG	4	Algeria	1	N	31	84	87	1	1	20,841	27,459	27,815	1.28	3.07	2.72	2.71	274	886
2	AO	7	Angola	1	Y	18	91	--	27	0	10,310	11,527	10,674	7.99	2.63	2.84	3.72	263	640
3	BN	53	Benin	1	Y	6	79	90	28	0	3,331	5,175	5,235	1.14	2.82	2.98	3.11	139	863
4	BC	20	Botswana	1	N	10	91	91	1	2	1,325	1,447	1,392	3.92	3.40	2.95	2.92	241	145
5	UV	233	Burkina Faso	1	N	29	85	85	29	0	7,965	10,165	10,069	0.95	2.50	2.64	2.81	97	351
6	BY	29	Burundi	2	Y	114	90	90	22	0	5,357	6,011	6,168	2.54	2.80	2.90	2.88	15	53
7	CM	32	Cameroon	2	Y	31	87	87	30	2	10,822	13,218	12,905	2.43	2.83	2.90	2.83	122	426
8	SP	203	Canary Islands	1	N	3	80	90	5	1	1,445	1,511	1,511	0.00	0.49	0.25	0.16	50	504
9	CV	35	Cape Verde	1	N	10	80	90	5	0	296	414	407	1.61	2.26	2.27	2.88	21	41
10	CT	37	Central African Rep.	2	Y	48	88	89	32	0	2,688	3,149	3,344	5.82	2.58	2.68	2.62	114	66
11	CD	39	Chad	1	N	14	88	92	6	1	5,428	6,309	6,183	2.03	2.28	2.03	2.71	301	451
12	CN	45	Comores Islands	1	N	4	80	91	2	0	394	635	630	0.74	3.42	3.56	3.68	23	159
13	CF	46	Congo	1	N	9	83	94	1	2	1,675	2,318	2,515	7.82	2.82	2.97	3.00	196	258
14	IV	107	Cote d'Ivoire	1	N	50	88	88	18	0	10,813	13,499	13,895	2.85	3.86	3.74	3.68	80	270
15	DJ	72	Djibouti	1	Y	5	83	93	2	0	259	451	496	9.12	4.46	2.92	3.01	65	90
16	EG	59	Egypt	1	N	26	86	86	1	0	46,718	56,133	57,285	2.01	2.58	2.39	2.20	194	2,159
17	EK	61	Equatorial Guinea	1	N	6	89	92	35	0	341	386	389	0.68	7.22	2.43	2.55	67	64
18	ER	997	Eritrea	2	Y	38	84	94	19	1	2,747	3,662	--	--	2.12	2.91	3.05	56	96
19	ET	62	Ethiopia	3	Y	550	84	94	19	1	39,868	53,143	56,316	0.87	2.12	2.91	3.05	45	97
20	GB	74	Gabon	2	Y	33	90	90	36	2	1,365	1,561	1,323	18.00	4.01	3.25	3.31	89	47
21	GA	75	Gambia, The	1	N	5	83	93	2	2	688	936	956	2.09	3.01	2.89	2.60	46	187
22	GH	81	Ghana	2	Y	107	84	94	43	2	12,206	16,698	16,944	1.45	3.58	3.14	3.00	46	156
23	GV	90	Guinea	1	Y	7	80	93	3	0	4,300	6,242	6,501	3.98	2.23	2.86	3.04	187	892
24	PU	175	Guinea-Bissau	1	Y	9	79	91	2	0	779	1,086	1,050	3.41	1.87	1.99	2.14	61	121
25	KE	114	Kenya	2	Y	43	89	89	8	0	21,836	25,835	26,975	4.23	3.56	3.42	3.35	116	601
26	LT	122	Lesotho	1	N	8	86	86	13	2	1,578	1,928	1,929	0.04	2.79	2.54	2.47	62	241
27	LI	123	Liberia	1	Y	9	84	94	37	2	2,102	2,902	2,941	1.31	3.17	3.16	3.32	104	322
28	LY	124	Libya	1	N	7	84	--	1	2	3,637	5,246	5,225	0.39	4.37	3.65	3.47	481	749
29	MA	129	Madagascar	2	Y	93	90	90	6/42	2	11,443	13,047	13,702	4.78	3.06	3.18	3.29	80	140
30	PO	998	Madeira	1	N	1	81	90	5	0	254	256	256	0.00	0.28	-0.07	0.03	29	256
31	MI	130	Malawi	2	Y	24	87	87	10	0	7,989	10,660	11,008	3.16	3.42	5.34	3.31	63	444

Num	Abb	UN Code	Country	Level used	2nd level avail?	Num of units	Ref year	Sched. census 85-95	Source	Agg flag	Country population (in 000) In ref yr (source)	In 1994 (projected)	In 1994 (UN est)	Abs. % error	Annual rates of change 80-85	85-90	90-95	Mean resolution in km	Mean pop per unit (in 000)
32	ML	133	Mali	2	Y	41	87	87	4/11	1	7,834	9,745	10,464	6.87	2.85	3.04	3.17	175	238
33	MR	136	Mauritania	1	N	12	92	87	38	0	2,081	2,204	2,270	2.90	2.60	2.73	2.86	295	184
34	MP	137	Mauritius	1	N	1	90	90	39	0	1,037	1,097	1,109	1.06	1.09	1.05	1.00	36	1,097
35	MO	143	Morocco	2	Y	42	90	92	1	0	25,208	27,768	27,601	0.60	2.56	2.58	2.40	127	661
36	MZ	144	Mozambique	1	N	10	87	95	1	0	14,361	16,605	15,823	4.94	2.27	0.94	2.83	279	1,660
37	WA	147	Namibia	1	N	26	91	90	44	0	1,410	1,551	1,635	5.14	2.94	3.06	3.18	177	60
38	NG	158	Niger	2	Y	35	88	88	40	1	7,250	8,798	8,813	0.17	3.36	3.14	3.26	184	251
39	NI	159	Nigeria	1	N	31	91	91	1	0	88,515	97,229	123,079	21.00	3.20	3.30	3.13	171	3,136
40	RE	182	Reunion	1	N	1	94	89	7	0	644	644	644	0.00	1.65	1.87	1.56	45	644
41	RW	184	Rwanda	1	N	10	91	91	23	0	7,165	7,934	8,057	1.52	3.27	2.87	3.40	48	793
42	TP	193	Sao Tome & Principe	1	N	2	83	91	5	0	100	129	130	1.07	2.39	2.32	2.20	21	64
43	SG	195	Senegal	1	Y	10	88	88	21	0	6,893	8,117	8,165	0.59	2.81	2.78	2.70	140	812
44	SE	999	Seychelles	1	N	1	94	87	7	0	73	73	73	0.00	2.87	3.29	0.89	14	73
45	SL	197	Sierra Leone	2	Y	12	85	85	12	2	3,516	4,552	4,616	1.39	2.93	3.07	2.66	77	379
46	SO	201	Somalia	1	Y	16	80	87	26	0	6,713	9,952	9,845	1.08	3.19	1.94	3.18	200	622
47	SF	202	South Africa	2	Y	292	91	91	25	2	37,015	43,349	41,749	3.83	2.58	2.44	2.37	64	148
48	SU	206	Sudan	2	Y	85	83	93	17	0	20,181	27,713	28,175	1.64	3.11	2.88	2.78	172	326
49	WZ	209	Swaziland	1	N	4	86	86	16	0	681	843	836	0.81	3.08	2.62	2.68	66	211
50	TZ	215	Tanzania	1	N	23	88	88	9	0	23,174	28,386	29,755	4.60	3.28	3.43	3.36	196	1,234
51	TO	217	Togo	2	Y	21	81	91	15	0	2,720	4,048	4,010	0.96	2.93	3.07	3.18	52	193
52	TS	222	Tunisia	1	N	23	84	94	2	0	6,966	8,620	8,757	1.56	2.57	2.08	2.06	82	375
53	UG	226	Uganda	2	Y	34	91	90	14	0	16,583	18,144	19,823	8.47	2.72	3.11	3.00	78	534
54	CG	250	Zaire	2	Y	31	84	94	41	0	29,671	41,026	42,476	3.41	3.18	3.32	3.17	273	1,323
55	ZA	251	Zambia	2	Y	54	90	90	24	0	7,818	8,779	9,132	3.87	3.58	3.40	2.84	117	163
56	ZI	181	Zimbabwe	2	Y	58	82	92	20	2	7,546	11,107	11,215	0.97	3.22	3.45	2.96	82	191
						sum	avg					sum	sum	mape	avg	avg	avg	avg	avg
						2223	86.2					691,423	724,291	3.13	2.89	2.75	2.75	123	485

Data sources

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Definitions

Level used: 1 = First level administrative unit, 2 = Second level
Scheduled census 85-95 round (planned or completed): According to Clarke and Rhind (1992)
Agg Flag: 0 = No aggregation, 1 = fewer pop data distributed to more admin units, 2 = more pop figures than admin units
U.N. population estimates and annual rates of change from:
United Nations (1993), World Population Prospects. The 1992 Revision, Department for Economic and Social Information and Policy Analysis, New York
Table A.5.: Annual interpolated mid-year population, by major area, region and country, 1985-2000, medium variant, p.184.
Table A.2.: Total population and annual rate of change by major area, region and country, 1950-2025, medium variant, pp. 160-161
Mean resolution in km: Square root of total area divided by number of admin units (area does not include major water bodies)
Mean pop per unit: Average number of people represented by each admin unit (1994 projections)

Notes by country

3 BN Second level added from 'Carte Administrative' accompanying the 1:600k IGN map 'Republique Populaire du Benin' (1984); 2nd level pop data unavailable.
5 UV Aggregated Kadiogo and Bazega provinces (Ouagadougou).
7 CM 2nd level boundaries and data for Centre, Est, Littoral, Nord-Ouest, Sud and Sud-Ouest provinces; 1st level for Adamaoua, Extreme-Nord, Nord and Ouest. The 2nd level data source showed a considerably smaller total population (9,057,147) than later official figures, which is probably due to subsequent adjustments for undercount. For that reason all regional figures for Cameroon were inflated by a factor of 1.19483, assuming the same percentage undercount in each region.
8 SP Using annual rates of change for Spain.
9 CV Admin units correspond to islands.
10 CT Official estimates; second level added from 'Carte Administrative' accompanying the 1:1.5mio IGN map 'Republique Centrafricaine' (1993).
11 CD Official estimates.
12 CN Incl. Mayotte (France; census year 1984).
14 IV One regional boundary added.
15 DJ Some additional data for 1989 available in source 33.
16 EG Excl. Egyptians abroad; see also source 34.
17 EK Official estimates.
18 & ER & The boundaries and data files were originally produced by USGS and obtained from the Int'l Food Policy Research Institute, Washington D.C. via ILRAD, Nairobi;
19 ET Data for newly independent Eritrea is from the same source; projections using growth rates for Ethiopia.

U.N. estimates for Ethiopia still include Eritrea. The abs % error therefore compares the combined projections for Ethiopia and Eritrea with the UN estimate for Ethiopia.
The national boundaries for Eritrea are assumed to be the same as the boundaries for Eritrea province in the last census.
For some Awrajas (2nd level units), the Wereda (3rd level) figures were inconsistent and the total Awraja population was distributed over the Weredas proportional to area: 18 Awrajas in Eritrea, Tigray and Harerge.
The 6 digit identifier in the original data was preserved by copying the first 4 digits into the LEVEL1 item, and the last 2 digits into the LEVEL2 item.
The first 2 digits identify the regions: 01-Arsi, 02-Bale, (03-Eritrea), 04-Gamo Gofa, 05-Gojam, 06-Gonder, 07-Harerge, 08-Ilubador, 09-Kefa 10-Shewa (incl. Addis Ababa), 11-Sidamo, 12-Tigray, 13-Welega, 14-Welo
The next 2 digits identify the Awraja, and the last 2 digits the Wereda.
I.e., the following INFO command would select all units in Bale: RESEL LEVEL1 GE 200 and LEVEL1 LT 300 AND CNT-ABB = 'ET'

20 GB Official estimates (from 1989); second level added from 'Carte Administrative' accompanying the 1:1mio IGN map 'Gabon' (1987)
Second level pop data for Estuaire, Haut-Ogooue, Moyen-Ogooue, Ngounie and Nyanga provinces; no second level data was included in the census publication for Ivindo, Lolo, Maritime and Ntem provinces.

22 GH Names did not match between coverage and census publication for about half of all census regions; census district names and lat/long coordinates were identified using a gazetteer for Ghana, the resulting points were overlaid onto coverage, and then allocated to the cov census regions into which they fell.

27 LI Population of territories were aggregated with the corresponding county.

28 LY 24 regional population figures were aggregated to 7 admin units for which boundaries were available.

29 MA Official 1990 estimates for 1st level (source 6) were distributed in proportion to the 1975 census figures for the 2nd level (source 42).

30 PO Using annual rates of change for Portugal

32 ML 1987 estimates for 1st level (source 11) were distributed in proportion to the 1976 census figures for the 2nd level (source 4)

33 MR Official estimates based on 1983 census

34 MP Official estimates. Data only for Island of Mauritius (boundaries for Island of Rodriguez - pop: 18012 - and others - pop: 350 - were not included).

35 MO Including Western Sahara.

36 MZ Official estimates based on 1980 census.

37 WA Namaland region added.

39 NI Boundaries that define states that were defined in '91 were added using a map produced by Magellan, Inc. (no scale, no ref); (existing boundaries were kept from FAO coverage).

40 RE Using official UN estimate (source 7).

44 SE Boundaries copied from WBDII; using official UN estimate (source 7).

45 SL Aggregated Port Loko and Western Area - incl. Freetown.

46 SO Official population total for 1980 is 5,074,000, while the official UN estimate for that year is 6,713,000.
As the UN figures are probably more reliable, all regional population totals were increased using the factor: 1.32302 .

47 SF The total population for South Africa is split up as follows:
Republic of South Africa (source 25 - 1991: 30,986,920), Bophutatswana (6 - 1985: 1,740,600), Ciskei (25 - 1990: 951,024), Transkei (6 - 1985: 2,876,122) and Venda (6 - 1985: 459,986).
Figures were consistently available for the main provinces; for the 'independent' homelands, some census districts could not be identified and these districts were aggregated into one unit each for Kwazulu in Natal (13 unidentified districts) and for Kangwane/Gazankulu/Lebowa/Kwandebele in Transvaal (10 districts).
The Heidelberg (JOH) region in the original coverage was split into: Johannesburg, Heidelberg, Alberton and Germiston.

50 TZ One regional boundary added.

54 CG Boundaries replaced by coverage produced by UNESCO/TSBF Nairobi (no map source specified); coverage obtained from GRID-Nairobi.

56 ZI Detailed population data were assigned to admin units using the Zimbabwe Land Classification Map, 1:10mio, of 1979 as a reference.

15

Appendix B: Attribute Definitions

Polygon Attributes

SQKM	Area of polygon in square kilometers. Derived by projecting coverage into equal area projection (Mollweide with central meridian 20E).
PERM–ID	"Permanent Id" : unique for each polygon.
DISS–ID	"Dissolve Id": all polygons that belong to the same administrative unit (i.e., units comprising of land areas and islands, or first level units that consist of several second level units for which no data could be found), have the same DISS–ID.
CODE	Type of polygon: 'L'–land, 'IS'–island, 'IW'–inland water bodies.
FLAG	Flag to identify a unique polygon for each administrative unit (i.e., each of the units for which unique population figures were found has only one polygon with a FLAG value of 1 – generally the largest poly –, all others are zero). Used for calculating summary statistics to avoid double counting.
CNT–NUM	Sequential numeric country code – see Appendix A.
CNT–CODE	U.N. numeric code for country – see Appendix A; n.a. for some countries.
CNT–ABB	2 letter abbreviation for each county – see Appendix A.
NAME1	Name of first level administrative unit.
TYPE1	Type of first level unit: 1–County, 2–Department, 3–District, 4–Division, 5–Governorate, 6–Island, 7–Prefecture, 8–Province, 9–Region, 10–State.
LEVEL1	Sequential number for each first level unit in a country.
POP1	Population in reference year for first level unit.
Y1	Population data reference year.
S1	Data source code – see Appendix A.
NAME2	Name of second level administrative unit.
TYPE2	Type of second level unit: 1–Arrondissement, 2–Cerules, 3–Department, 4–District, 5–Prefecture, 6–Statistical Region, 7–Subdivision, 8–Sub–Region, 9–Province.
LEVEL2	Sequential number for each second level unit belonging to the same first level unit.
POP2	Population in reference year for second level unit.
Y2	Population data reference year for second level unit.
S2	Data source code – see Appendix A.
POPEST94	Estimated population in 1994 based on an exponential growth model and average annual growth rates from the U.N. Statistical Office – see text.
POPDENS94	Population density based on POPEST94. Derived by adding up the areas (SQKM) of all 'L' and 'IS' polygons belonging to the administrative unit, and dividing POPEST94 by this total area. Inland water bodies have thus not been considered in the density calculation.

Arc Attribute

FEATURE	Type of boundary: 0 – zero level (international) boundary 1 – first level administrative unit 2 – second level administrative unit 3 – third level administrative unit (only present for Ethiopia) 7 – islands in inland water bodies 8 – inland water bodies 9 – coastline and offshore islands